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BURDEN OF CHRONIC MALNUTRITION AND ASSOCIATED FACTORS AMONG UNDER FIVE CHILDREN IN EASTERN ZONE OF TIGRAY, NORTHERN ETHIOPIA; A COMMUNITY BASED CROSS SECTIONAL STUDY.

Gebremedhin Gebreegziabiher* and Haftay Gebremedhin

Adigrat University College of Medicine and Health Sciences, department of Public health, Ethiopia.

***Corresponding Author: Gebremedhin Gebreegziabiher**

Adigrat University College of Medicine and Health Sciences, department of Public health, Ethiopia.

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ABSTRACT

Introduction: Malnutrition is insufficient, excessive or imbalance consumption of dietary energy and nutrients. Children that are malnourished tend to have increased risk of morbidity and mortality and often suffer delayed mental development, poor school performances and reduced intellectual achievement. Malnutrition is responsible, directly or indirectly, for 54% of the 10.8 million deaths per year in children under five. The objective of this study is to assess the burden of chronic malnutrition and associated factors among under five children in three randomly selected Districts of Easetrn zone of Tigray. **Method**: A community based cross sectional study was used and it was conducted between May 1/2014 and January 30/2015 in Eastern zone of Tigray, Northern Ethiopia. A total of three Districts from the zone and six Tabias from each district were selected by simple random sampling technique/lottery system. A total of **796** children were selected by simple random sampling method. Primary data was collected by a combination of structured questionnaire and collection of anthropometric data. The data was entered in to Epi-Info 3.5.1; cleaned and all errors/outliers were corrected. Then the data was transported to SPSS 16.0 for final analysis and anthropometric data was analyzed using ENA for SMART software. Binomial and multinomial logistic regression analyses were performed to identify factors associated with chronic malnutrition (stunting). **Result:** data was collected from all of the 796 children indicating 100% response rate. The prevalence of stunting among the study participants was 57.03%. Age of children below 12 months and frequency of diarrhea per year were significantly associated with stunting with AOR of 1.74 and 3.14 respectively. **Conclusion:** Age of children below 12 months and frequency of diarrhea per year were significantly associated with stunting.

KEY WORDS: Stunting, Under five children, Northern Ethiopia, cross sectional study.

Background and Justification

Malnutrition is insufficient, excessive or imbalance consumption of dietary energy and nutrients. It manifests in different forms, such as under nutrition, over nutrition and micronutrients malnutrition. Malnutrition in early childhood is associated with functional impairment in adult life as malnourished children are physically and intellectually less productive when they become adults. Children that are malnourished tend to have increased risk of morbidity and mortality and often suffer delayed mental development, poor school performances and reduced intellectual achievement[1].

Tracking Progress on Child and Maternal Nutrition drew attention to the impact of high levels of under-nutrition on child survival, growth and development and their social and economic toll on nations. Just a few years ago, nutrition was a neglected area of development, and the nutrition community was fragmented, lacking a common voice or unified approach. Stunting serves as a marker for poverty and underdevelopment[2].

The UNICEF conceptual framework defines nutrition and captures the multi-factorial causality of under-nutrition. Nutritional status is influenced by three broad factors: food, health and care. Optimal nutritional status results when children have access to affordable, diverse, nutrient-rich food; appropriate maternal and child-care practices; adequate health services; and a healthy environment including safe water, sanitation and good hygiene practices. These factors directly influence nutrient intake and the presence of disease. The interaction between under-nutrition and infection creates a potentially lethal cycle of worsening illness and deteriorating nutritional status[2]. About 54% of deaths among children of this age group are believed to be associated with malnutrition in developing countries[3].

Stunting and other forms of under-nutrition are clearly a major contributing factor to child mortality, disease and disability. For example, a severely stunted child faces a four times higher risk of dying, and a severely wasted child is at a nine times higher risk[4]. Poor foetal growth,

small size at birth and continued poor growth in early life followed by rapid weight gain later in childhood raises the risk of coronary heart disease, stroke, hypertension and type II diabetes[5]. The developmental impact of stunting and other forms of under-nutrition happens earlier. Brain and nervous system development begins early in pregnancy and is largely complete by the time the child reaches the age of 2. The timing, severity and duration of nutritional deficiencies during this period affect brain development in different ways, influenced by the brain's need for a given nutrient at a specific time[6]. Attaining optimal growth before 24 months of age is desirable; becoming stunted but then gaining weight **disproportionately** after 24 months is likely to increase the risk of becoming overweight and developing other health problems[7].

Knowledge of the impact of stunting and other forms of under-nutrition on social and economic development and human capital formation has been supported and expanded by more recent research[8-10]. Reduced school attendance and educational outcomes result in diminished income-earning capacity in adulthood. A 2007 study estimated an average 22 per cent loss of yearly income in adulthood[11]. Under-nutrition early in life clearly has major consequences for future educational, income and productivity outcomes. Stunting is associated with poor school achievement and poor school performance[12,13]. Recent longitudinal studies among cohorts of children from Brazil, Guatemala, India, the Philippines and South Africa confirmed the association between stunting and a reduction in schooling, and also found that stunting was a predictor of grade failure[14].

Undernourished girls have a greater likelihood of becoming undernourished mothers who in turn have a greater chance of giving birth to low birth weight babies, perpetuating an intergenerational cycle[15]. Poor maternal nutrition impairs foetal development and contributes to low birth weight, subsequent stunting and other forms of under-nutrition[16]. Evidence from 54 low- and middle-income countries indicates that growth faltering on average begins during pregnancy and continues to about 24 months of age. This loss in linear growth is not recovered, and catch-up growth later on in childhood is minimal[17]. After birth, a number of practices can directly lead to poor growth: inadequate breastfeeding practices such as non-exclusive breastfeeding; inappropriate complementary feeding, such as starting at the wrong age; poor access to or use of diverse types of food and inadequate intake of micronutrients. Poor growth can be aggravated further by frequent incidence of infectious diseases like diarrhoea, malaria or infestation with intestinal worms[2].

Globally, more than one quarter (26 per cent) of children under 5 years of age were stunted in 2011 – roughly 165 million children worldwide. But this burden is not evenly distributed around the world. Sub-Saharan Africa and South Asia are home to three fourths of the world's stunted children. In sub-Saharan Africa, 40 per cent of children under 5 years of age are stunted; in South Asia, 39 per cent are stunted. Progress in reducing stunting prevalence in sub-Saharan Africa was limited to 16 per cent, from 47 per cent in 1990 to 40 per cent in 2011. More than one third of countries in sub-Saharan Africa have very high stunting prevalence. Globally, over one third of children in rural households are stunted compared to one quarter in urban households. Girls and boys are almost equally likely to be stunted globally, but in sub-Saharan Africa stunting afflicts more boys (42 per cent) than girls (36%)[18].

Globally in 2011, an estimated 101 million children under 5 years of age were underweight, or approximately 16 per cent of children under 5. Underweight prevalence is highest in South Asia, which has a rate of 33 per cent, followed by sub-Saharan Africa, at 21 per cent. South Asia has 59 million underweight children, while sub-Saharan Africa has 30 million. The prevalence of underweight children under age 5 is an indicator to measure progress towards MDG 1, which aims to halve the proportion of people who suffer from hunger between 1990 and 2015. Globally the prevalence of underweight is decreased by 37%, has declined from 25% to 60%, but only 26% reduction in sub-Saharan Africa[18].

Moderate and severe wasting represents an acute form of under-nutrition, and children who suffer from it face a markedly increased risk of death. Globally in 2011, 52 million children under 5 years of age were moderately or severely wasted, an 11 per cent decrease from the estimated figure of 58 million in 1990. More than 29 million children under 5, an estimated 5 per cent, suffered from severe wasting. The highest wasting prevalence is in South Asia, where approximately one in six children (16 per cent) is moderately or severely wasted. The burden of wasting is highest in India, which has more than 25 million wasted children. In sub-Saharan Africa, nearly 1 in 10 children under the age of 5 (9 per cent) were wasted in 2011, a prevalence that has decreased about 10 per cent since 1990. [19].

Ethiopia is one of the developing countries with high prevalence of malnutrition. Under-five children mortality is among the highest in the world (ranking 16th) with a magnitude of 77/1000 live births. Stunting is one of the most important public health problems in Ethiopia. A national survey undertaken in 2011 among under five years children showed that the proportion of stunted, underweight and wasted children were 44 %, 29% and 10% respectively[20].

Different studies have reported that malnutrition is the main public health problem among under five children in Ethiopia. Despite high prevalence of malnutrition among under five children, there is limited information on the prevalence and associated factors of malnutrition in rural

areas like eastern zone of Tigray. Therefore the aim of this study was to determine prevalence and associated factors of malnutrition among under five children at Eastern zone of Tigray regional state, where there is dearth of information; so that appropriate prevention and control strategies can be designed.

Method

Stuudy design: A cross-sectional community based study was used.

Source population: all under five children living in Eastern zone of Tigray regional state.

Study population: under five children living in the three randomly selected Districts.

SAMPLE SIZE DETERMINATION AND SAMPLING TECHNIQUE

Sample size determination

The sample size is calculated by single population proportion using the formula adopted from Fisher et al (1991) according to the following assumptions, prevalence of chronic malnutrition among under five children = 44% taken from EDHS 2011[20], with 95% confidence interval and marginal error 5 % and design effect=2. The calculation resulted in a sample size of 758 children. To increase the representativeness of the sample, design effect of 2 was used. Five percent (5% = 37.9~38) of the total sample size was added as an attrition rate for any non-response of the study subjects during the study period. Therefore, the actual sample size of the study was **796 children**.

Sampling technique

Multi stage sampling technique was used. Three Districts were selected from the zone by simple random sampling technique (lottery system). Six Tabias were selected from each District by simple random sampling technique (lottery system). The size of households to be selected from each District and Tabia is based on the size of population of children living in each District and Tabia. In the three Districts, three groups of data collectors; and three Health extension workers in each group) were assigned and they have selected the required number of households (children) from each Tabia after preparing sampling frame. From the selected Tabias the required number of households with children has been selected by simple random sampling technique in collaboration with health extension workers and Tabia administrator. The names of the heads of households with children with in the specified age have been listed in alphabetical order. Sampling proportional to size was applied. If more than one child within the specified age group within the house hold one child was selected by lottery system.

Anthropometric measurement: Nutritional status of under five children was assessed by anthropometric measurement of height for age. Height of the children was measured and recorded in cm using standard measuring device. During measurement, children were without their shoes. The age of the children was obtained by interviewing parents or guardians. After these measurements Z—score of height for age (HAZ) was assessed by ENA for SMART soft ware using WHO standard. Based on the derived Z-score, type of chronic malnutrition has been identified as stunted if HAZ is <-2SD.

***Factors associated with malnutrition*:** Scio-economic and other associated factors were obtained by interviewing parents or guardians using standard questionnaire. Parents or guardians have been interviewed to obtain information on religion, ethnicity educational status, monthly income and other important factors.

STUDY VARIABLES

Dependent: Chronic Malnutrition (Stunting)

Independent: House hold income, Maternal education, Birth order, Source of water and availability of toilet facility, Employment status of mother, Age of child, ANC visit, Sex of the child and Number of children in the house hold.

DATA COLLECTION TOOLS AND PROCEDURES

A standard questionnaire was prepared to collect data during the data collection period. An English version was prepared. However, during training the questionnaire was translated into the local language (Tigrigna). Translated questionnaire was translated back to English and compared to the original questionnaire. Primary data has been collected in 18 randomly selected Tabias of the three Districts by a combination of structured questionnaire and collection of anthropometric data through measurements of height and MUAC of children. The anthropometric measurement by WHO standard (WHO 2006) was used for the determination of nutritional status of under five children. Six BSc graduated health professionals were engaged to administer the questionnaire in the form of interview and conduct anthropometric measurements. Health extension workers and Tabia administrator help in the preparation of sampling frame in each Tabia for simple random sampling. The health extension workers assist in showing the location of the selected households and in data collection.

- Height and length board: this instrument was used to take height/length measurements for children.
- MUAC tape: a special tape for measuring MUAC of children.
- Recumbent length was measured from children aged below 24 months and standing height was measured from children aged 24-59 months.

Mothers/care givers were interviewed using standardized questionnaire. Enumerators took anthropometric measurements from selected children.

DATA MANAGEMENT AND QUALITY CONTROL

A three-day training session for all data collectors and supervisors has been given. Before commencement of the actual study, the study tools and instruments have been pre-tested in one Tabia of Hawzen district which was not included in the study to prevent information contamination. The data collectors completed a total of 80 questionnaires (10% of the total sample size) and all pre-tested questionnaires were entered on computer to test the practicability of data entry. Necessary changes on the questionnaire have been done accordingly. The three supervisors in the three Districts also perform continuous follow up and early correction of errors.

DATA ANALYSIS

All the collected data was entered in to Epi-Info 3.5.1. The data was cleaned and all errors were corrected after verification with actual questionnaires. Data was transported from Epi-Info 3.5.1 to SPSS 16.0 for final analysis. The analysis was made with binary logistic regression to see the significant relation of selected independent variables with the dependent variable. Independent variables found significant (with P-value<0.05) were entered to multiple logistic regression to control the effect of confounding. Frequency distributions, percentages and odds ratios (OR) with 95% confidence interval (C.I) are calculated for statistical significance tests between variables and the analyzed data is presented via tables, graphs and texts. All the tests are considered significant at p<0.05 level. Anthropometric data was analyzed using ENA for SMART software.

OPERATIONNAL DEFINITIONS

1. **Stunting:-** (height-for-age below -2SD of the WHO Child Growth Standards median) among children under five years of age; and
2. **MUAC:-** children with MUAC of <12cm and ≥ 11cm are considered as mildly malnourished and those <11cm are considered as severely malnourished.

RESULT AND DISCUSSION

Result

Socio-demographic characteristics

A total of 796 under five children were included in the study giving response rate of 100%. The mean age of the children was 27.38 months with a SD of 16.83 months. Of total households involved 716 (79.95%) were rural and 80 (10.05%) were urban. The majority of mothers were married 703 (88.32%), Orthodox Christian religion followers 788 (98.99%). Only 390 (49.00%) of the mothers were able to read and write. The prevalence of Stunting was almost similar in the illiterate and literate mothers whereas underweight and wasting were high in those children whose mothers can't read and write (144 (35.47%) and 61 (15.02%)) compared to children whose mothers were educated up to higher level (103 (26.41%) and 50 (12.82%)) respectively. Father's occupation in the present study indicates that 527 (74.97%) were farmers, 80(11.38%) were employed, 77(10.95%) were daily laborers and 19(2.70%) were merchants. Around three-fourth (74.00%) of the households earn monthly income of more than one thousand. Households with one child age birth-59 months were 488 (61.31%); two children were 285 (35.80%) and three children were 23 (2.89). More than half of the households (59.42%) have farm land; 82.54 use pipe water and 84.80% have latrine (Table1).

Table 1: Socio-demographic and other characteristics, Eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

Variable		Frequency	Percent
Religion	Orthodox	788	98.99%
	Muslim	8	1.01%
Marital status	Married	703	88.32%
	Single/temporary	70	8.79%
	Divorced	18	2.26%
	Widowed	5	0.63%
educational status	Illiterate	406	51.00%
	1-8(elementary)	264	33.17%
	9-12(secondary)	112	14.07%
	diploma and above	14	1.76%
Occupation of mother	House wife	688	86.43%
	Farmer	43	5.40%
	Employed	27	3.39%
	Daily laborer	25	3.14%
	Merchant	13	1.64%
Occupation of father	Farmer	527	74.97%
	Daily laborer	77	10.95%
	Employed	80	11.38%
	Merchant	19	2.70%
Mother's decision making power on	Yes	680	85.43%

spending money	No	116	14.57%
ANC follow up	Yes	781	98.12%
	No	15	1.88%
Number of ANC follow up	Zero	15	1.88%
	<4 times	443	55.66%
	>=4 times	338	42.46%
Contraceptive use	Yes	546	68.59%
	No	250	31.41%
Type of contraceptive	Injection	393	71.98%
	Implano	133	24.36%
	Pill	13	2.38%
	IUCD	7	1.28%
Took training on child feeding	Yes	627	78.77%
	No	169	21.23%
Availability of farm land	Yes	473	59.42%
	No	323	40.58%
Availability of animals	Yes	584	73.37%
	No	212	26.63%
Availability of latrine	Yes	675	84.80%
	No	121	15.20%
Source of water	Pipe water	657	82.54%
	River	123	15.45%
	Well	16	2.01%
Monthly income birr	<500	16	2.01%
	500-999	191	23.99%
	1000-1499	325	40.83%
	>=1500	264	33.17%

4.1.2 Child characteristics

More than half of the total children (54.15%) were females. Households with one child age birth-59 months were 488 (61.31%); two children were 285 (35.80%) and three children were 23 (2.89). The mean age of children was 27.38 months with SD of 16.83 months. Almost all of the eligible children (98.31%) were supplemented with Vitamin A in the past six months and 97.49% children were immunized. Around two-third of the total children (68.97%) were born in health facility. Less than half of the children (45.85%) are still on breast feeding. Most mothers (57.70%) stop to breast fed their children by considering it is enough and 35.74% stop to breast fed due to pregnancy. Around 8.29% of the total children had diarrhea during the data collection period. Almost half of the total children (49.37%) start breast feeding immediately after birth. More than one-third of the total children (36.68%) start complementary feeding before six months. Significant number of children (46(5.78%)) took pre-lacteal food. Around three fourth (72.17%) of the total children ate three times a day (Table 2).

Table 2 characteristics of the children, eastern zone of Tigray-Northern Ethiopia, 2015 (n= 796)

Variable		Frequency	Percent
Number of under five children	1	488	61.31%
	2	285	35.80%
	3	23	2.89%
Sex	Female	431	54.15%
	Male	365	45.85%
Immunization status	Yes	776	97.49%
	No	20	2.51%
Vitamin A supplementation (in the past 6 months)	Yes	696	98.31%
	No	12	1.69%
Birth situation	Single	769	96.61%
	Twin	27	3.39%
Place of birth	Health facility	549	68.97%
	Home	247	31.03%
Current breast feeding status	Yes	365	45.85%
	No	431	54.15%
Reason to stop breast feeding	Child is old enough to stop	253	58.70%

	Mother becomes pregnant	154	35.74%
	Child hate B/F	12	2.78%
	Maternal health problem	12	2.78%
Current diarrhea status	Yes	66	8.29%
	No	730	91.71%
Febrile	Yes	17	2.13%
	No	779	97.87%
Time of initiation of B/F	Within one hour	393	49.37%
	1-24hrs	372	46.73%
	After one day	28	3.52%
	Did not start B/F	3	0.38%
Starting complementary feeding	Before 6 months	292	36.68%
	At six months	340	42.70%
	After six months	76	9.55%
	Still on EBF	88	11.06%
Pre-lacteal food	Yes	46	5.78%
	No	750	94.22%
Number of meals per day	One times	5	0.71%
	Two times	58	8.19%
	Three times	511	72.17%
	Four or more times	134	18.93%
Feeding material	By hand	348	49.15%
	By spoon	343	48.45%
	By cup	17	2.40%

1.1.3 Level of malnutrition among children

The prevalence of stunting among the study participants was 57.03%. The prevalence of stunting was more among males. The prevalence of stunting was highest among children aged 12-23months and lowest among children aged less than six months. (Table 3).

Table 3 Level of chronic malnutrition among children, Eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

		Stunting	
		Yes	No
Malnutrition		454(57.03%)	342(42.97%)
Sex	Female	230(53.36%)	201(46.64%)
	Male	224(61.37%)	141(38.63%)
Age range	=<6 months	12(11.43%)	93(88.57%)
	7-11 months	50(58.14%)	36(41.86%)
	12-23 months	118(73.47%)	43(26.53%)
	24-35 months	117(70.24%)	50(29.76%)
	36-47 months	85(62.96%)	50(37.04%)
	48-59 months	72(50.70%)	70(49.30%)

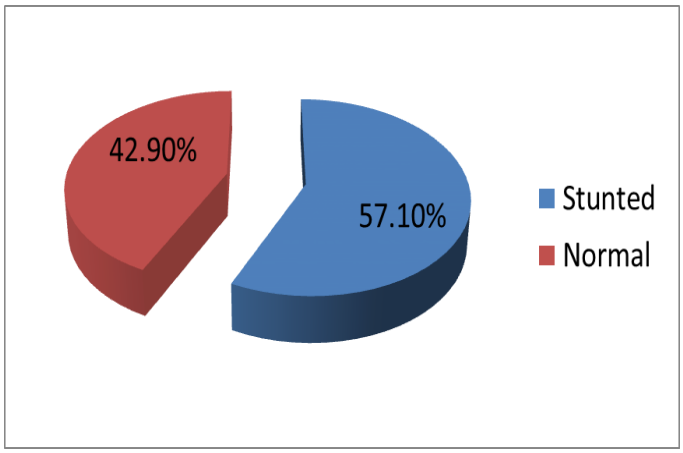

Figure 1 level of chronic malnutrition among under five children, Eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

As indicated in the following figure, males were more stunted than females.

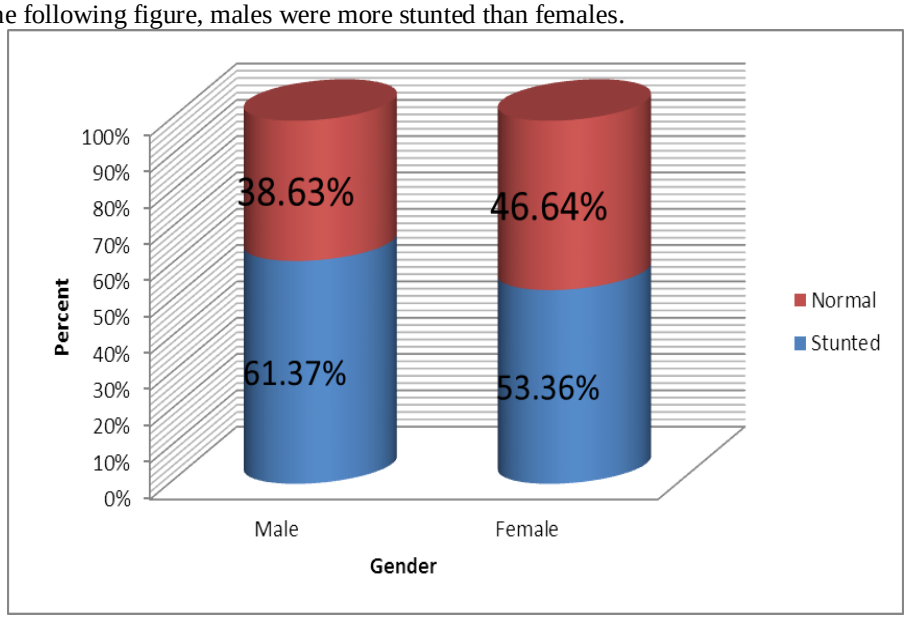

Figure 2 degree of chronic malnutrition among males and females, Eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

4.1.4 Degree of chronic malnutrition among children

More than one-fourth of the children (29.27%) were severely stunted and 27.76% of children were moderately stunted (Table 4).

Table 4 Degree of chronic malnutrition among under five children, Eastern zone of Tigray- Northern Ethiopia, 2015 (n=796).

Variable		Frequency	Percent
Stunting	Severely stunted	233	29.27%
	Moderately stunted	221	27.76%
	Normal	321	40.33%
	2SD - <3SD	8	1.01%
	>=3SD	13	1.63%

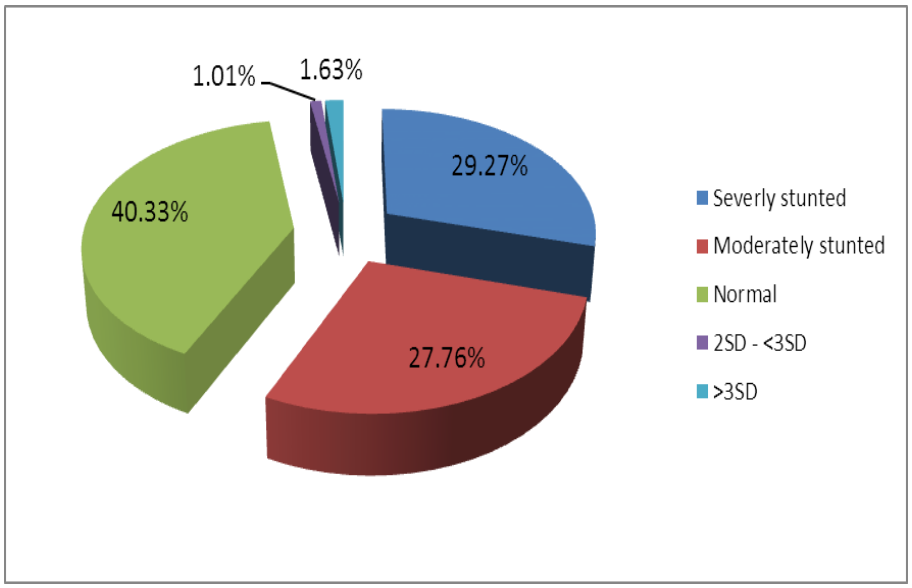

Figure 3 degree of chronic malnutrition among under five children, Eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

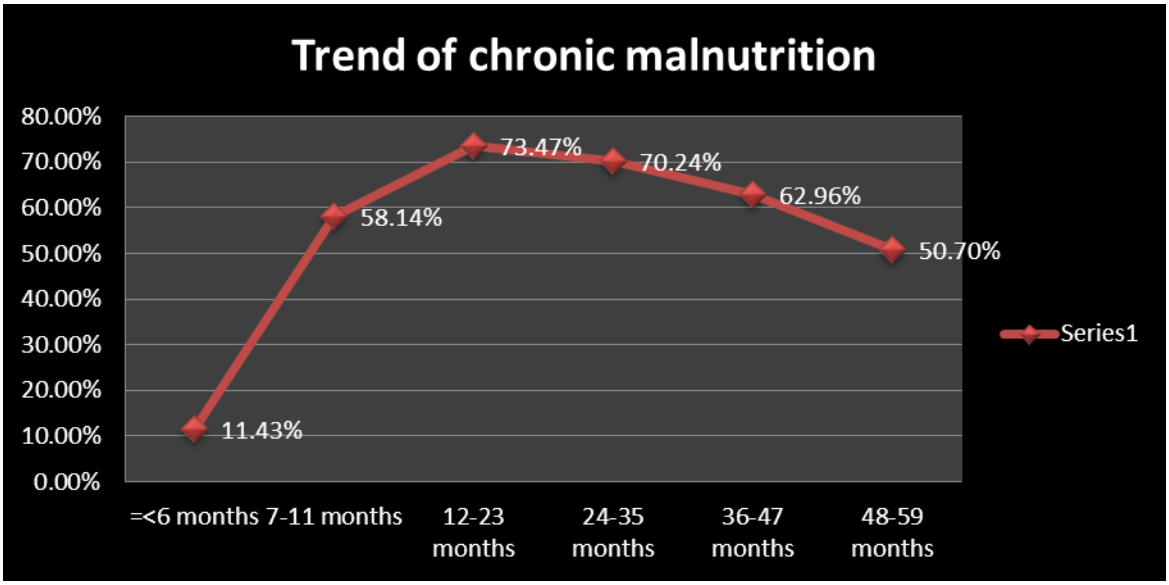

Figure 4 Trends of chronic malnutrition among different age groups, Eastern zone of Tigray-Northern Ethiopia, 2015 (796).

As age of children increases, level of stunting gradually decrease. Stunting is more prevalent among middle age children (12-35months).

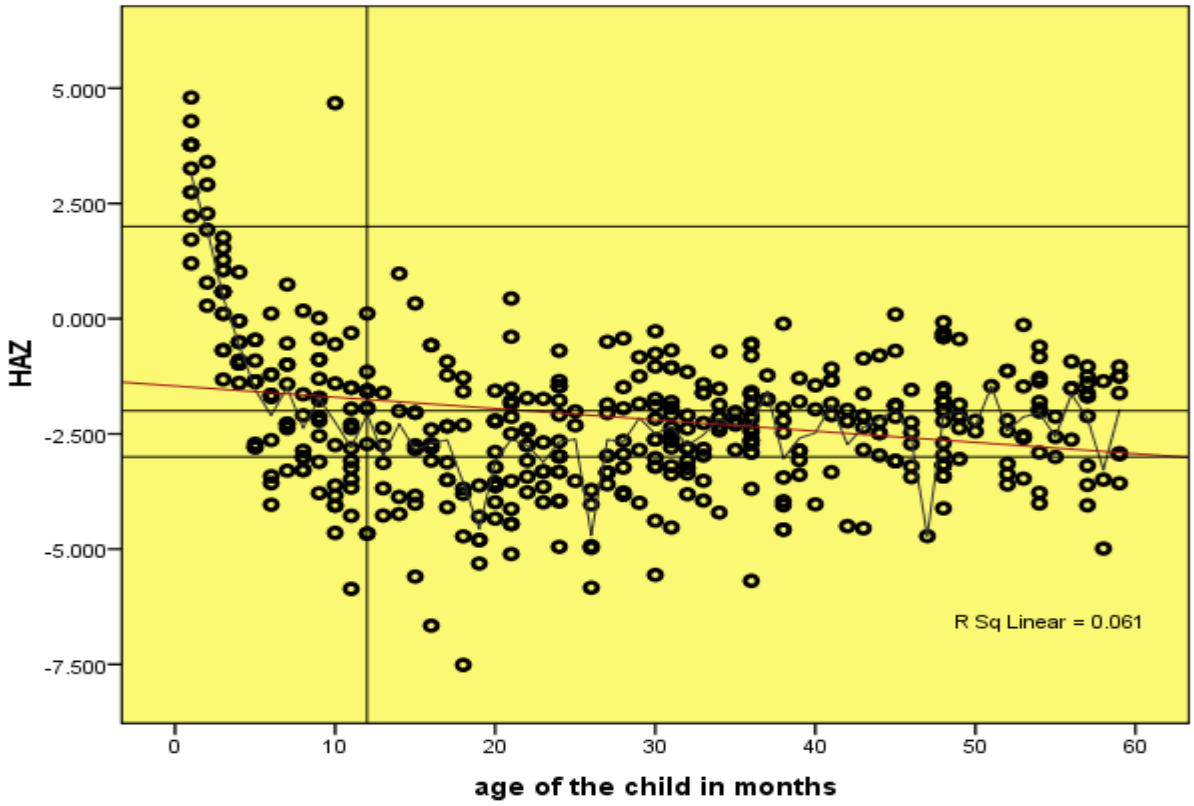

Figure 5 changes in stunting with age, Eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

Association test

Association of different factors with stunting

Age and number of diarrhea per year were significantly associated with stunting. Over 12months children had 74% more probability of becoming stunted than the younger children. Number of diarrhea per was also significantly associated with stunting. As the number of diarrhea per year increases, the chance of becoming stunted increases. Children with 3 or more number of diarrheas per year have 3.14 times more probability of becoming stunted. Availability of latrine was associated with stunting in bivariate logistic regression. But it was not significantly associated in multivariate logistic regression (Table 5).

Table 5 Association of different factors with stunting, eastern zone of Tigray-Northern Ethiopia, 2015 (n=796).

Variable		Stunting		p	OR		P
		Yes (n(%))	No (n(%))		COR(95%CI)	AOR(95%CI)	
Sex	Male	224(61.37%)	141(38.63%)	0.082	1		
	Female	230(53.36%)	201(46.64%)		.723(.502, 1.042)		
Age	<12months	61(31.94%)	130(68.06%)	0.000	1	1	0.004
	>=12months	393(64.96%)	212(35.04%)		3.903(2.498, 6.100)*	1.736(1.190, 2.534)*	
Place of delivery	Home	146(59.10%)	101(40.90%)	0.557	1		
	Health facility	308(56.10%)	241(43.90%)		.889(.601, 1.316)		
Single/twin	Single	443(57.61%)	326(42.39%)	0.279	1		
	Twin	11(40.74%)	16(59.26%)		.574(.210, 1.567)		
Diarrhea	Yes	46(69.70%)	20(30.30%)	0.089	1		
	No	408(55.89%)	322(44.11%)		.453(.269, 1.097)		
Number of diarrhea/year	=<2times	366(53.74%)	315(46.26%)	0.001	1	1	0.000
	>=3times	88(76.52%)	27(23.48%)		2.848(1.576, 5.147)*	3.141(1.708, 5.778)*	
Pre-lacteal feeding	Yes	21(45.65%)	25(54.35%)	0.244	1		
	No	433(57.73%	317(42.27%)		1.577(.733, 3.391)		
Duration of B/F	<20months	55(67.90%)	26(32.10%)	0.355	1		
	>=20months	211(60.29%)	139(39.71%)		.733(.380, 1.415)		
Family size	=<5	200(57.80%)	146(42.20%)	0.752	1		
	>5	254(56.44%)	196(43.56%)		.943(.655, 1.358)		
Size of farm land	>=0.5 hectare	132(55.70%)	105(44.30%)	0.743	1		
	<0.5 hectare	322(57.60%)	237(42.40%)		1.068(.720, 1.585)		
Educational status of mother	Illiterate	235(57.88%)	171(42.12%)	0.766	1		
	Literate	219(56.15%)	171(43.85%)		.933(.592, 1.470)		
Monthly income	>=1000EBrr	333(56.53%)	256(43.47%)	0.729	1		
	<1000EBrr	121(58.45%)	86(41.55%)		1.076(0.712, 1.626)		
Complementary feeding	<6 months	179(61.35%)	113(38.70%)	0.503	1		
	>=6 months	269(64.66%)	147(35.34%)		1.146(.769, 1.707)		
Availability of Latrine	Yes	368(54.52%)	307(45.48%)	0.009	1	1	0.525
	No	86(71.07%)	35(28.93%)		2.063(1.199, 3.552)*	1.184(.703, 1.993)	
Pipe water	Yes	373(56.77%)	284(43.23%)	0.799	1		
	No	81(58.27%)	58(41.73%)		1.064(.660, 1.715)		
MUAC	>=12cm	423(62.85%)	250(37.15%)	0.102	1		
	<12cm	28(80.00%)	7(20.00%)		2.517(.831, 7.618)		
No- of meals/day	>=3times	406(62.95%)	239(37.05%)	0.525	1		
	<3times	43(68.25%)	20(31.75%)		1.261(.617, 2.577)		
Marital status	Married	391(55.62%)	312(44.38%)	0.086	1		
	Other	63(67.74%)	30(32.26%)		1.682(.930, 3.042)		
No- of children before	=<2	207(57.82%)	151(42.18%)	0.708	1		
	>=3	247(56.39%)	191(43.61%)		.933(.648, 1.343)		
Age of the mother	=<24years	51(50.50%)	50(49.50%)				
	>=25years	403(57.99%)	292(42.01%)				

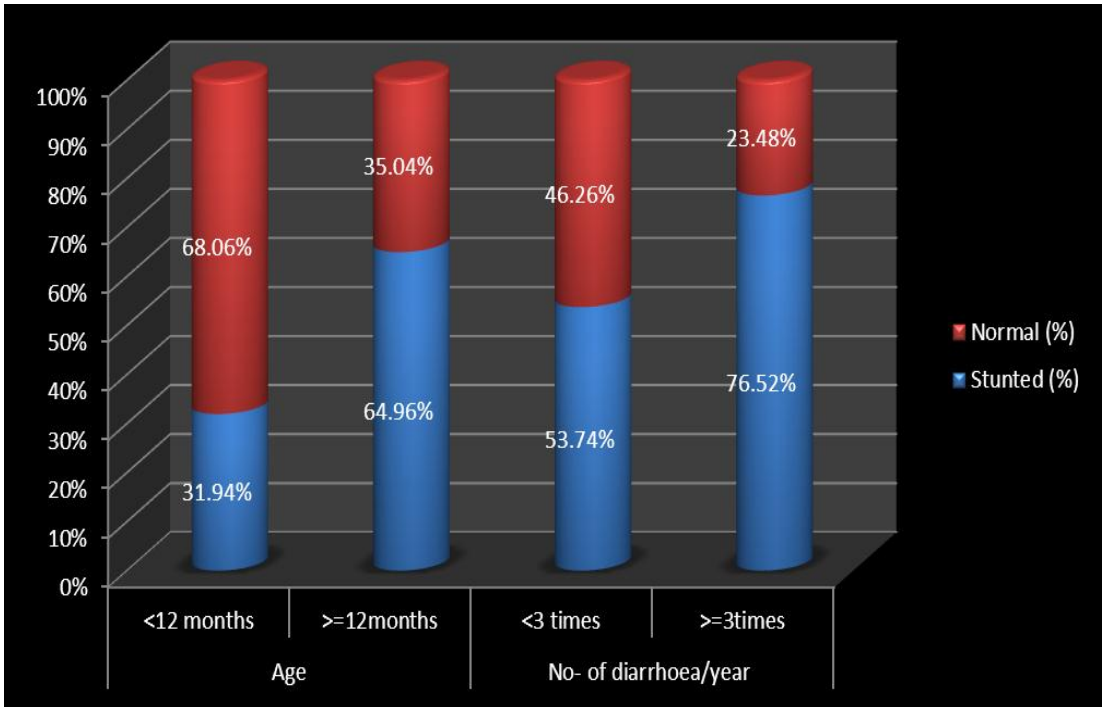

Figure 6 Association of stunting with age and number of diarrhea per year among under five years children, Eastern zone-Northern Ethiopia, 2015 (n=796).

4.2. DISCUSSION

The prevalence of stunting among the study participants is 57.03%. This is higher than the findings of EDHS 2011 (44%)[20]. Study conducted in Ethiopia (North Shewa, Eastern Harerge zone, West gojam zone and Dollo ado district) revealed that the prevalence of stunting is lower than our finding[21-24]. Study done in Nigeria and Iran also indicated that the prevalence of stunting is lower than our finding[25,26].

The prevalence of stunting in younger children is lower than in the older ones. Children younger than one year have prevalence of 31.94% and the prevalence among 12 moths and older is 64.69%. The prevalence is lowest (11.43%) among children younger than 6months and highest (73.47%) among children aged 12-23months. The main reason for this may be because when food is in scarce supply within a household, it is customary to distribute whatever is available starting from the youngest members of the household. Moreover, the height of younger kids may not be seriously affected if the households have food problem due to their dependence on breast milk. Similar finding from studies done in Ethioopia (North Shewa, Eastern Harerge zone, West Gojam zone and Dollo Ado District) and Democratic Republic of Congo.[22-24,27,28]

Children with more frequency of diarrhea per year are more likely to be stunted. The prevalence of stunting among children with 3 and more frequency of diarrhea is 76.52% and the prevalence of stunting among children with 2 and fewer frequency of diarrhea is 53.74%. This could be due to the effect of diarrhea on nutrient absorption and this in turn can lead to negative energy balance and malnutrition. Place of delivery is not significant predictor of stunting in our finding. This research finding revealed that income is not significantly associated with stunting. Study conducted in Democratic Republic of Congo found an association between stunting and family income[28]. We found that MUAC is not significantly associated with stunting.

There is no difference in level of chronic malnutrition with gender, educational status of the mother, availability of latrine, availability of clean water, family size, pre-lacteal feed, family planning utilization, initiation of breast feeding and complementary feeding in this study. With respect to gender and maternal education, study conducted in Pakistan revealed the same finding[21,29]. Study done in Democratic Republic of Congo revealed association of gender with stunting (males being stunted than females)[28] and in Iran gender was significantly associated only with stunting[26]. Finding from Dollo Ado District of Somali regional state also indicated that stunting is more common among boys than girls[24]. Another study done in Ethiopia also indicated that males were more stunted[30].

CONCLUSION

The prevalence of stunting among the study participants is 57.03%. This is higher than the national and regional prevalence of the EDHS 2011. Government bodies and other stake holders should work together to alleviate the chronic malnutrition as this finding is beyond what the government expects. Age of children below 12 months and frequency of diarrhea per year were significantly associated with stunting with AOR (95%CI) of 1.74(1.19,2.53) and 3.14(1.71,5.78) respectively. More

emphasis should be given for children during supplementary feeding and weaning period. Addressing hygiene and environmental sanitation is also an important component in addressing chronic malnutrition as this could have important contribution in reducing diarrheal diseases.

ETHICAL CONSIDERATION

An ethical approval was obtained from Adigrat University college of Medicine and health Sciences. Support letter was inquired from Tigray regional health bureau and health offices of the three Districts for conducting the study. Information on the study has been given to the mother/care giver including the study purposes, procedures, potential risks and benefits. Data collectors and supervisors were trained by focusing on the issue of informed consent, privacy and confidentiality. All mothers/care givers of children selected for the study have been informed about the purpose and significance of the study to get their written consent and their full right to refuse, withdraw or completely reject to be included in the study was ensured. Written informed consent was obtained from mothers or caregivers of children selected for the study. Participants name was not documented to assure confidentially. The right of participants to anonymity and confidentiality was assured by making the questionnaire anonymous. The raw data was handled with key and locked system and the information was not handover to third party. In addition, scientific honesty was made as much as possible by citing properly all Authors of journals that were used, and acknowledging Scholars, individuals and organizations contributed for the successful completion of this research paper.

Competing interests

I declare that I have no competing interests.

Authors' contribution

GG conceived and designed the study, analyzed the data and wrote the manuscript.

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REFERENCES

1. Smith, LC, Haddad, L. *Explaining Child Malnutrition in Developing Countries:* A Cross-Country Analysis. IFPRI FCND Discussion Paper 1999 No. 60, IFPRI, Washington, D.C. USA.
2. UNICEF's Report. Improving child nutrition, the achievable imperative for global improvement. April 2013
3. FAO. *The State of Food Insecurity in the World 2008*. Food and Agriculture Organization, Rome.
4. Black, Robert E., et al., 'Maternal and Child Undernutrition: Global and regional exposures and health consequences', *Lancet*, vol. 371, no. 9608, 19 January 2008, pp. 243–260.
5. Norris, Shane, et al., 'Size at Birth, Weight Gain in Infancy and Childhood, and Adult Diabetes Risk in Five Low and Middle Income Country Birth Cohorts', *Diabetes Care*, vol. 35, no. 1, 18 November 2011, pp. 72–79.
6. Cusick, Sarah E., and Michael K. Georgieff, 'Nutrient Supplementation and Neurodevelopment: Timing Is the Key', *Archives of Pediatrics and Adolescent Medicine*, vol. 166, no. 5, May 2012, pp. 481–482.
7. Kuzawa, Christopher W., et al., 'Birth Weight, Postnatal Weight Gain, and Adult Body Composition in Five Low and Middle Income Countries', *American Journal of Human Biology*, vol. 24, no. 1, January– February 2012, p. S62.
8. Victora, Cesar G., et al., 'Maternal and Child Undernutrition: Consequences for adult health and human capital', *Lancet*, vol. 371, no. 9609, 26 January 2008, p. 340.
9. Almond, Douglas, and Janet Currie, 'Human Capital Development before Age Five', *Handbook of Labor Economics*, vol. 4B, 2011, pp. 1315–1486.
10. Martorell, Reynaldo, et al., 'The Nutrition Intervention Improved Adult Human Capital and Economic Productivity', *Journal of Nutrition*, vol. 140, no. 2, February 2010, pp. 411–414.
11. Grantham-McGregor, S., et al., 'Developmental Potential in the First 5 Years for Children in Developing Countries', *Lancet*, vol. 369, no. 9555, 6 January 2007, p. 67.
12. Dewey, Kathryn G., and K. Begum, 'Long-term Consequences of Stunting in Early Life', *Maternal and Child Nutrition*, vol. 7, October 2011, pp. 5–18;
13. Grantham-McGregor, S., et al., 'Developmental Potential in the First 5 Years for Children in Developing Countries', *Lancet*, vol. 369, no. 9555, 6 January 2007, p. 65.
14. Martorell, Reynaldo, et al., 'Weight Gain in the First Two Years of Life Is an Important Predictor of Schooling Outcomes in Pooled Analyses from Five Birth Cohorts from Low- and Middle-Income Countries', *Journal of Nutrition*, vol. 140, no. 2, February 2010, pp. 348–354.
15. Özaltin, Emre, Kenneth Hill and S. V. Subramanian, 'Association of maternal stature with offspring mortality, underweight, and stunting in low- to middle-income countries'. *JAMA*, vol. 303, no. 15, 21 April 2010, pp. 1507–1516.
16. Walker, Susan P., et al., 'Inequality in Early Childhood: Risk and protective factors for early child development', *Lancet*, vol. 378, no. 9799, 8 October 2011, pp. 1328, 1334.
17. Victora, Cesar G., et al., 'Worldwide Timing of Growth Faltering: Revisiting implications for interventions', *Pediatrics*, vol. 125, no. 3, 1 February 2010, p. e473.
18. Global and regional estimates consistent with the UNICEF, WHO, World Bank Joint Child Malnutrition Estimates from analysis of the Joint

Global Nutrition database from 1990 to 2011.
19. UNICEF Global Nutrition Database, 2012.
20. Central Statistical Agency [Ethiopia] and ORC Macro. *Ethiopia Demographic and Health Survey 2011*. Addis Ababa, Ethiopia, and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro.
21. *Ullah et al*. Malnutrition amongst Under-Five Years Children in Swat, Pakistan: *Trop J Pharm Res, August 2014; 13(8):* 1367.
22. Tadiwos Zewdie and Degnet Abebaw. Determinants of Child Malnutrition: Empirical Evidence from Kombolcha District of Eastern Hararghe Zone, Ethiopia: Quarterly Journal of International Agriculture 52 (2013), No. 4; DLG-Verlag Frankfurt/M.
23. Beka Teshome, Wambui Kogi-Makau, Zewditu Getahun, Girum Taye. Magnitude and determinants of stunting in children under five years of age in food surplus region of Ethiopia: The case of West Gojam Zone; *Ethiop. J. Health Dev*. 2009;23(2)
24. Solomon Demissie, Amare Worku. Magnitude and Factors Associated with Malnutrition in Children 6-59 Months of Age in Pastoral Community of Dollo Ado District, Somali Region, Ethiopia. *Science Journal of Public Health.* Vol. 1, No. 4, 2013, pp. 175-183. doi: 10.11648/j.sjph.20130104.12.
25. Akorede & Abiola. Assessment of Nutritional Status of under five children in Akure south local government, Ondo state, Nigeria: IJRRAS 2013, 14 (3).
26. Kavosi E, Hassanzadeh Rostami Z, Kavosi Z, Nasihatkon A, Moghadami M, Heidari M. Prevalence and determinants of under-nutrition among children under six: a cross-sectional survey in Fars province, Iran. *Int J Health Policy Manag* 2014; 3: 71–76. doi: 10.15171/ijhpm.2014.63.
27. Mengistu K, Alemu K, Destaw B (2013) Prevalence of Malnutrition and Associated Factors Among Children Aged 6-59 Months at Hidabu Abote District, North Shewa, Oromia Regional State. J Nutr Disorders Ther T1: 001. doi:10.4172/2161-0509.T1-001.
28. Kandala et al. Malnutrition among children under the age of five in the Democratic Republic of Congo (DRC), BMC Public Health 2011, 11:261.
29. **Rayhan *et al.*** Factors Causing Malnutrition among under Five Children: Pakistan Journal of Nutrition 2006, 5 (6): 558-562.
30. Tadiwos Zewdie and Degnet Abebaw. Determinants of Child Malnutrition: Quarterly Journal of International Agriculture 52 (2013), No. 4; DLG-Verlag Frankfurt/M.